

SUBLIMATOR/VAPORIZER

[0001] This application claims the benefit of the earlier filing date of U.S. Provisional Application No. 62/195,240, filed Jul. 21, 2015.

BACKGROUND

[0002] In a typical sublimator or vaporizer, a substance (also referred to here as a chemical) is placed into a canister that is heated to a sufficiently high temperature that causes the substance to sublime (solid to vapor) or vaporize (liquid to vapor), in the canister. While the substance is heated, the regions where the vapor is formed will cool, due to the latent heat of vaporization, yielding an inconsistent vaporization rate.

[0003] The approaches described above in this section are approaches that could be pursued, but not necessarily approaches that have been previously conceived or pursued. Therefore, unless otherwise indicated, it should not be assumed that any of the approaches described in this section qualify as prior art merely by virtue of their inclusion in this section.

SUMMARY

[0004] An embodiment of the invention is an apparatus for vaporization or sublimation of a substance. A chamber body (e.g., that of a canister) is to hold a substance therein that is being vaporized or sublimated. A temperature-regulated plate is moveable in the chamber body. The temperature of the movable plate is controlled by means such as a resistive heater, a radiant heater, an inductive heater or a thermoelectric heater. The bottom face of the plate rests on the substance, inside the chamber body, such that the plate releases heat directly above the substance. In this manner, heat released from the plate may supplement at least part of the energy that is lost through cooling (latent heat of vaporization) at the top surface of the substance. This may yield a consistent evaporation/sublimation environment even as the substance is consumed, because the heat releasing plate slides down with, and therefore remains adjacent to, the substance being consumed.

[0005] In one embodiment, the chamber body has a sidewall joined to a bottom, and an open top that is covered by a lid. An outlet may be formed in the lid, to draw out the vapor (where the vapor may optionally be in a mixture of vapor and a carrier gas.) The plate may be connected to the lid, e.g., through tubing in which a thermal fluid is being circulated to control temperature of the plate. Note however that the opening (of the body chamber) does not have to be located at its top; also, the plate need not be connected to the lid. As an example, the opening may be formed in a bottom of the body chamber. Also, the plate may be connected to a portion of the chamber body other than its lid assembly, e.g., its sidewall.

[0006] In one embodiment, the outermost edge of the plate may be shaped to conform to the inner surface of the sidewall of the chamber body so as to cover as much of the substance as possible while allowing the plate to slide downward within the chamber body as the substance is vaporized or sublimated.

[0007] The above summary does not include an exhaustive list of all aspects of the present invention. It is contemplated that the invention includes all systems and methods that can be practiced from all suitable combinations of the various

aspects summarized above, as well as those disclosed in the Detailed Description below and particularly pointed out in the claims filed with the application. Such combinations have particular advantages not specifically recited in the above summary.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The embodiments of the invention are illustrated by way of example and not by way of limitation in the Figures of the accompanying drawings in which like references indicate similar elements. It should be noted that references to an or “one” embodiment of the invention in this disclosure are not necessarily to the same embodiment, and they mean at least one. Also, in the interest of conciseness and reducing the total number of Figures, a given Figure may be used to illustrate the features of more than one embodiment of the invention, and not all elements in the Figure may be required for a given embodiment.

[0009] FIG. 1 illustrates an embodiment of an apparatus for vaporization or sublimation of a substance.

[0010] FIG. 2 is an exploded view of an example sublimator/vaporizer having coiled inlet and outlet tubings that connect the plate to the lid.

[0011] FIG. 3 is a section view of the apparatus of FIG. 2 fitted with a carrier gas mechanism.

[0012] FIG. 4 is a cutaway view of the apparatus of FIG. 2 taken up into the chamber body.

[0013] FIG. 5 is an example of tubing used by the apparatus depicted in FIG. 2 as inlet or outlet tubing.

DETAILED DESCRIPTION

[0014] Several embodiments of the invention with reference to the appended drawings are now explained. Whenever the shapes, relative positions and other aspects of the parts described in the embodiments are not explicitly defined, the scope of the invention is not limited only to the parts shown, which are meant merely for the purpose of illustration. Also, while numerous details are set forth, it is understood that some embodiments of the invention may be practiced without these details. In other instances, well-known structures and techniques have not been shown in detail so as not to obscure the understanding of this description.

[0015] FIG. 1 illustrates an embodiment of an apparatus for vaporization or sublimation of a substance. The substance may be a solid precursor that is to be sublimated within a chamber, or it may be a liquid chemical that is to be vaporized in the chamber. The apparatus shown is composed of a chamber body 1 having a sidewall 2 that is joined to a bottom 3, and an open top. The sidewall 2 may be cylindrical as shown for example in FIG. 2. The chamber body 1 may be a canister, such as one that is metallic and is made of a material that can hold a substance (against the bottom 3) that is to be vaporized or sublimated into a vapor, but that should not react with the substance. The canister may be manufactured using any suitable process, e.g., centrifugal casting. The open top of the chamber body 1, through which the canister may be filled with the substance, may be covered by a lid 4 that once fitted in place as shown may fully enclose the chamber within the chamber body 1. Note that during the vaporization/sublimation process, the lid 4 may remain secured to the top edge of the chamber